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ABSTRACT

The influence of story schema development on children's attention to television and memory of program content was examined in a study that involved two separate testing sessions. The expectation was that maximum effort would be given to program elements most central to comprehension of a television story and that this allocation strategy would be most evident for children who understood the structure of stories and could use this knowledge to guide allocation of attention effort. In the first testing session, children (5 to 8 years old) watched two stories on television and their schema skills were assessed after viewing each story. In the second session, children watched a television story (primary task) and depressed a button in response to periodic tones (secondary task). Reaction time to the secondary task was the measure of attention to the primary task. The development of story schema was found to be related to reduced processing effort, increased memory of central story content, increased efficiency, and greater flexibility of capacity allocation strategies. Results also suggested that capacity allocation was a function of both perceived task difficulty and the type of mental operations children performed while watching television stories. (Author/HOD)

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CHILDREN'S ATTENTION TO TELEVISION: THE INFLUENCE OF STORY SCHEMA DEVELOPMENT ON ALLOCATION OF MENTAL EFFORT AND MEMORY

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ABSTRACT

Children's Attention to Television:
The Influence of Story Schema Development on
Allocation of Mental Effort and Memory

This study examined the influence of story schema development on children's attention to television and memory of program content. A 2 (story schema) X 2 (story structure) X 2 (story content) factorial design was used, requiring two separate testing sessions. In the first session, children (5 to 8 years old) watched two stories on television, and their schema skills were assessed after viewing each story. Performance in this session was used to assign children to high or low schema groups for the next phase of the study. In the second session, children watched a television story (primary task) and depressed a button in response to periodic tones (secondary task). Reaction time (RT) to the secondary task was the measure of attention to the primary task. Story structure was also manipulated in this session. Children in high and low schema groups were randomly assigned to view either a program structured like a story (program episodes were related and included typical story grammar elements) or a program with no underlying story structure (program episodes were from several program stories and were unrelated).

The development of story schema was found to be related to reduced processing effort, increased memory of central story content, increased efficiency, and greater flexibility of capacity allocation strategies. Results also suggested that capacity allocation is a function of both perceived task difficulty and the type of mental operations children perform while watching television stories.

Children's Attention to Television: The Influence of Story Schema Development on Allocation of Mental Effort and Memory

Attention as a variable in mass communication research has been valued primarily as a predictor of learning (Hawkins, Ibok, & Pingree, 1983; Reeves, Thorson, & Schleuder, 1984). In the past decade, however, researchers interested in children's response to television began to look at attention as a cognitive process worthy of investigation in its own right (Hawkins, et al., 1983; Reeves, et al., 1984). This literature has identified cognitive strategies children use to visually attend to television and has determined when these strategies emerge and how they influence comprehension.

Anderson and his colleagues have identified a strategy for dividing visual attention between television viewing and other activities (Lorch, Anderson & Levin, 1979). In executing this strategy, children do not allocate visual attention continuously to television programs. Instead, visual selection is guided by a goal to comprehend a program and by structural features of the program such as movement and voices. Children divide visual attention between television and other activities and monitor the audio track for cues associated with important parts of the program. Once such cues appear, attention is directed to the television which continues until content becomes incomprehensible or uninteresting. Results showed that this strategy emerges between 2 to 5 years of age and is efficient by age 5 when children allocate minimal visual attention to television without loss of program comprehension.

Anderson and Smith (1983), however, recognized that program comprehension involves more than looking at the television at appropriate times. Although children appear to actively guide visual attention to television to increase

comprehension, understanding of television programs is often fragmentary and incomplete. They stated, "The paradox is this: if young children's visual attention is effectively guided to the television program in the service of comprehension goals, then how can these strategies be so ineffective that no continuity of cognition obtains across scenes?," (p. 37).

The problem may be resolved by considering that attention involves intensity as well as selection. The amount of effort given to processing messages once they are selected should influence or reflect what children do with television content they watch. Mature attention should involve strategies for allocating effort and for meaningful organization of program elements.

The present study examined attentional effort as a function of story schema development. The expectation was that maximum effort would be given to program elements most central to comprehension of a television story and that this allocation strategy would be most evident for children who understood the structure of stories and could use this knowledge to guide allocation of attention effort.

The Development of Story Schema

Story schema are defined as memory structures which consist of clusters of knowledge about stories and how they are typically structured (Mandler & Johnson, 1977) and the ability to use this knowledge in processing stories (Piaget, 1926; Thorndyke & Yekovich, 1979). Mandler and Johnson (1977) stated that story schema emerge as children gain experience with stories and learn how events are typically sequenced and the probable causal relationships between story grammar elements. This experience leads to the development of a generalized story schema abstraction or prototype of a typical

story. In addition, schemata are flexible and are refined through experience (Thorndyke & Yekovich, 1979); through experience, story schema structures change to accommodate new information (Schank & Abelson, 1977).

Evidence shows that children gain knowledge about how stories are structured by about 5 years of age (Brown, 1975; Applebee, 1977); however, it is not until children are about 7 years old that they develop skills to use this knowledge as aids in processing complex stories (Brown & French, 1976). The earliest studies of story schema development were conducted by Piaget (1926). He claimed that development of story schema is constrained until children reach concrete operations (about 7 years of age). Before this, children have not yet developed the ability to seriate, to put events in correct temporal order (Piaget, 1969). According to Piaget, therefore, children younger than 7 years of age would not be expected to have developed story schema, since these children lack the ability to form mental representations of a series of events.

Other studies, however, have found that story schema emerge much earlier than Piaget predicted (Brown, 1975; Applebee, 1977; Mandler & Johnson, 1977). Results of these studies suggest that children are familiar with story grammar and are able to seriate events from simple stories before the age of 7. Brown (1975) reported a series of experiments designed to test Piaget's claims. She noted that his explanation rested on the assumption that children are not able to seriate before the onset of concrete operations (before about 7 years of age). In one study, Brown and French (1976) found that preoperational children do not exhibit the same stability in seriation skills as adults. Preoperational children, they noted, had been found to perform like adults only in studies where researchers used very simple stories. Brown and French

(1976) studied children (kindergarten, second, and fourth graders) and found that children younger than 7 years of age were able to reconstruct series from simple stories. When story structure was more complex, however, these skills proved unstable, and performance faltered.

Evidence, therefore, tends to contradict Piaget's conclusion that preoperational children are not equiped with cognitive skills necessary for the development of story schema. Research shows that even by 5 years of age, children have a basic understanding of story grammar and that when story structure is simple, preoperational children are able to form mental representations of a series of events, linking them together on the basis of real time order. When story structures are more complex, however, seriation skills prove unstable, and children's ability to use story schema knowledge in processing the story falters. This is an important point, since most stories (and certainly all television stories) are more complex than those typically used in this literature (e.g., they involve different event sequences and subplot structures).

How Story Schema Guide Attention to Stories

Because of the way story schema are organized, seriation is an essential skill necessary for utilizing schema knowledge to direct attention. Story schema are organized hierarchically, with the most important information stored at the top of the hierarchy. Hierarchical organization has important implications for what content is selected for attention, how incoming story information is organized, the amount of cognitive effort allocated to the task, how story content is stored in memory, and what story content is likely to be remembered (Thorndyke & Yekovich, 1969; Schank & Abelson, 1977).

The basic mechanism influencing organization and memory is the process of instantiation (Thorndyke & Yekovich, 1969). Instantiation occurs when

individuals encode incoming information, matching information from a particular story with structural variables in the schema hierarchy (e.g., problem, resolution, and outcome of a story). According to Schank and Abelson (1977), this process enables schemata to serve as organizational frameworks, allowing individuals to understand stories with a minimum of processing effort. Instantiation also helps one predict or anticipate the presentation of important story content (Thorndyke & Yekovich, 1969). The process of matching incoming information from a particular story with elements in the schema prototype enables one to generate expectations about what information will appear later in the story, given the variable slots already defined. An implication of prediction is that a story's structure will influence how effectively schema operate in guiding attention and memory processes. Research has shown that the more closely a story's structure matches the schema prototype and schema expectations, the more likely it is that stories will be interpreted correctly and be recalled accurately (e.g., Frederiksen, 1975; Kintsch, 1977; Mandler, 1978; Stein & Glen, 1979).

Instantiation influences memory in two ways. First, as instantiation occurs, information is stored hierarchically like the schema prototype. Also, given hierarchical storage, memory for central story content should be better than memory of incidental content. This should occur, because retrieval is a top-down process (Thorndyke, 1977). Studies about written stories have shown that information stored at the top of the hierarchy (central story content) is remembered better than incidental content (e.g., Kintsch & Keenan, 1973; Thorndyke, 1975; Yekovich & Thorndyke, 1980).

In summary, instantiation helps the individual devise efficient strategies for attending to written stories. It is also clear that instantiation will not function effectively, unless the reader is able to seriate, to put events in correct temporal order. Through instantiation processes, the story schema

prototype acts as a framework for organizing incoming information, enabling a reader to predict the presentation of important story content. The ability to anticipate when central content will be presented helps direct attention, selecting important content and allocating cognitive effort to processing this content. In addition, schema processing is efficient, requiring less effort overall for effective task performance. Finally, instantiation affects storage, influencing memory so that central story content is more likely to be remembered than incidental story content. A focal assumption in the present study is that story schema will affect the processing of television stories in a similar way.

Media researchers have, in fact, suggested that schemata influence strategies children adopt for allocating visual attention to television (Collins, 1981; Anderson & Lorch, 1983). Anderson and Lorch (1983), for example, stated that attending to television is an "ongoing cognitive processing of television (which is) to a great extent schema driven," (p. 6). They stated that because children are thought to gradually acquire relevant schema constructs and knowledge about the medium, attention to television programs is expected to be more or less reactive to stimulus characteristics. Compared to the attention style of adults, therefore, a child who has less knowledge and experience would be expected to be more reactive to television stimuli and to exhibit less evidence of schema-based attention strategies.

There is also evidence that visual attention to television programs exhibits schema processing characteristics. Collins, Wellman, Kinston, and Westby (1978), for example, studied children in the second, fifth, and eighth grades and found that memory for central program content improved with the child's grade and that recognition of central content was best when programs were structured in a logical (rather than a random) way. Studies examining children's visual attention to program attributes (e.g., motion and voices)

also suggest that schema influence development of strategies for selecting appropriate program content to look at. These studies have shown that between the ages of 3 to 8 years, children's visual attention to television is guided less by reactions to external stimuli and is characterized more by the operation of visual selection guided by knowledge of program structure and the ability to anticipate presentation of content (Anderson and Lorch, 1983; Krull & Husson, 1980). The development of mature attention strategies, therefore, is assumed to be in the direction of increasing control over attentional processes; increased flexibility, efficiency, and strategic deployment of visual selection; and improved program comprehension. These findings are consistent with results of nonmedia research in psychology concerning the development of visual attention strategies (Gibson & Rader, 1979; Vurpillot, 1968, e.g.).

It is important to note that many skills associated with the development of mature strategies for allocating visual attention to television are those identified as characteristic of schema operations. Therefore, it is hypothesized here that the development of mature strategies for attending to television stories is dependent upon the development of story schema constructs. As schema skills develop, the coordination of schema, attention, and memory processes becomes increasingly interdependent. The result is an increasingly efficient and strategic attention pattern, one which utilizes schema in an effort to allocate attentional resources in a way that maximizes performance and minimizes processing effort.

Measurement of Attention as Cognitive Effort

Attention is defined here as a cognitive process that is inherently selective (favoring some stimuli over others) and that requires mental effort. One of the most basic assumptions about mental effort is that capacity is limited (Broadbent, 1958; Kahneman, 1973). There are features of processing

capacity that are consistent across theories and measures of attention (Posner, 1982). Most important to the assessment of cognitive effort is that many processing tasks are performed successively and the amount of interference one produces for another can be used as a measure of processing demands.

An appropriate strategy for measuring attention effort is suggested by Kahneman's (1973) attention allocation theory. The basic assumption in his theory is that attending to something requires mental effort, a limited resource. He also assumes that the amount of effort one can allocate in attending to stimuli at a given time is limited by a total capacity. Because of this, when people are faced with performing simultaneous tasks, they allocate attentional resources between tasks. According to Kahneman, the amount of effort allocated is a function of task difficulty and if the combined tasks require more attention than available from capacity, performance on one or more tasks suffers.

An implication of Kahneman's theory is that attention can be measured by the dual task method that requires individuals to perform two tasks simultaneously -- an ongoing primary task (like reading a book) and a periodic secondary task (like depressing a lever whenever hearing a particular tone). Attention allocated to the primary task is measured by noting variations in performance on the secondary task, typically measured as accuracy or reaction times (Kerr, 1973; Kahneman, 1973; Norman & Bobrow, 1975; Posner, 1978). The underlying assumption is that there is a fixed attention capacity (100 percent effort) and that individuals allocate capacity between the two tasks. Allocation of effort to one task, therefore, necessarily implies a corresponding decrease in attention allocated to the second task. It is further assumed that there is a direct allocation-performance tradeoff, so that when much effort is allocated to one task, performance on the other suffers.

Similar assumptions are made in the present research. It is assumed that attending to television requires mental effort. When asked to watch television (the ongoing primary task) and to depress a button in response to periodic tones (the secondary task), children are expected to allocate capacity resources between these tasks. When reaction times on the secondary task are very fast, it is assumed that the child is not allocating much effort to the television story. When reaction times are slow, however, it is assumed that performance on the secondary task has deteriorated, because the child has allocated available resources to attending to television.

This method has been used by Britton and his colleagues to measure adult's capacity allocation when reading written passages (e.g., Britton & Tesser, 1982) and by Thorson, Reeves, and Schleuder (1984) to measure adult's capacity allocation to television stimuli. Findings show that adults who know more about a topic allocate more effort when reading stories than adults who know little about the topic (Britton and Tesser, 1982) and that more capacity is allocated in attending to simple stimuli than when attending to complex stimuli (Britton, Westbrook, & Holdredge, 1978; Reeves, Thorson, & Schleuder, 1984). These findings are, of course, counterintuitive and inconsistent with schema theory predictions, particularly the expectation that schema knowledge would be associated with reduced processing effort.

It is argued here, however, that these findings are instructive, because they suggest that reaction time measures in the dual task method can be used to measure two distinct types of processing phenomenon. A closer look at how Britton interprets the notion of cognitive capacity is enlightening here. He interprets his findings to mean that "cognitive capacity was filled by the reading task more completely when easy passages were being read than when difficult passages were being read," (pp. 588-589). In his work, therefore,

capacity is viewed as a function of cognitive involvement or demands voluntarily placed on cognitive processing when reading texts. When readers know a lot about a particular topic, they tend not only to use this information to organize incoming information, but also to integrate information from memory with information in the text. Britton, Glynn, Meyer, and Penland (1982) stated that this type of integration makes the experience more meaningful. When reading or viewing complex stimuli or when reading passages about unfamilar topics, this type of integrative process is less likely, and the task, therefore, fills capacity less than simple stimuli or familiar topics. In schema theory, however, reduced processing effort is an indicator of how effectively schema knowledge is used in directing encoding, attention, and storage. Effort allocation in this case is an indication of the efficiency of a child's basic information processing skills: the more skilled the processor, the less effort is required to complete a task.

Reaction times, therefore, have two distinct meanings in these situations. Schema theory predicts that reaction times reflect the efficiency of basic processing skills. If children can use story schema to coordinate encoding, attention, and memory, information processing is less costly in terms of effort required to accomplish the task or processing ease. In Britton's work, however, reaction times are an indication of additional cognitive effort invested to enhance the basic experience by integrating what is already known with information presented. Since the subjects in Britton's studies were all adults, it is not surprising that capacity allocation in their research has not uncovered this type of variance. All adults are expected to be able to use schemata effectively. Variance due to schema skills, therefore, is held fairly constant, and effort allocation varies between subjects only as a function of the types of cognitive operations they chose to engage.

In this study, reaction time (RT) is expected to uncover both types of variance. In making comparisons between groups of children with different levels of schema skills, the amount of effort allocated is expected to reflect differences in how effectively children are able to execute schema operations in attending to the television story. Children in the low schema skills group are expected to allocate more effort in attending to the television story than children in the high schema skills group who are better able to use schema knowledge in directing selection, allocation, and memory. In making comparisons within a particular skill group, however, RT is an indicator of the amount of effort allocated in performing additional cognitive operations (such as semantic integration) on information from television stories. Children in the high schema skills group, for example, are expected to treat content from a television story with logical structure differently than they would treat content from a television story without meaningful structure.

Methods

Research Design and Procedures

A 2 (story schema skill) X 2 (program structure) X 2 (story content) factorial design was used requiring two separate testing sessions for each child. In the first session, children participated in three activities. They were first engaged in a practice task to familarize them with the "story games." Story games involved completion of three assessment tasks: (1) sequencing pictures from the story; (2) selecting pictures that represented the most important story content; and (3) a recognition task to test for memory of story content. Children were instructed that the "story games" would be played later with stories they would see on television. This practice session was important in order to insure that children understood what the task would

be when they viewed television and to insure they would understand procedures involved in each story game. After the practice, children watched two stories on television: "The Three Robbers" and "Leopold, the See-Through Crumbpicker." Immediately after viewing each program, children participated in a testing session, completing the story games. Performance on these tasks was used to assign children to high and low schema skill groups for the next phase of the experiment.

In the second testing session, children were tested individually and were randomly assigned to experimental viewing conditions. Children assigned to the story structure condition viewed a typical story: scenes were ordered sequentially and the plot unfolded according to schema expectations. In the nonstory structure condition, children saw different episodes from several "He Man" stories. The episodes were unrelated and were not connected by an underlying story structure. As children watched the video tapes, their reaction times to periodic tones were recorded. Children were given instructions about the secondary task and each participated in a practice session that allowed them to respond to tones without any visual presentation on the television screne. Before viewing the "He Man" program, children were instructed to pay close attention to the television story so they could do well when they played the story games after the program was over. They were also asked to look only at the television screen. As children watched the story, their eye movements were recorded. Whenever a tone sounded, an experimenter noted whether or not the child was looking at the television. After viewing the program, children were asked to complete the same three assessment tasks performed in the first testing session. Children in the nonstory structure condition were also asked if they noticed anything different about the story they had just seen in order to assess whether they had noticed the story structure manipulation.

Sample

Children (N=40) were recruited from four daycare centers in Madison, Wisconsin and were 5 to 8 years of age. All testing was conducted between July 30 through August 16, 1984.

Stimulus Preparation

Session One. For the schema skills testing session, 16 mm films were transfered to video tape. One tape ("Leopold") included only a musical soundtrack and an adaptation of the story text was recorded on a second audio channel. Picture books were also obtained for each story, and 18 illustrations from each were shown to 10 adult judges who viewed each video tape and identified which pictures represented central story content. Eight pictures from each story were selected for use in the schema pretest. The pictures represented content from several points throughout each story and included pictures of central and incidental material. Since the video-taped stories were animated from illustrations in the book, pictures used in the sequencing and sorting tasks were the exact pictures children saw on television.

Session Two. The story structure tape was edited to maintain the basic story line and one subplot and included both central and incidental story content. Preparation of the tape for the nonstory structure condition met two criteria: (1) episodes violated schema expectations that episodes be related and connected by an underlying story structure; and (2) some episodes were identical to those in the story structure tape and were placed at the exact point in elapsed time as they appeared in the story structure condition. This made it possible to vary the program structure and to allow for comparisons between structure condition of effort allocated to the same content and at the same point in elapsed program time.

When editing these tapes, the audio was recorded only on audio channel 1. A total of 96 tones were randomly recorded on channel 2 (approximately 4 tones per minute), and the tones were placed at the exact point in elapsed time in both tapes.

Tapes for both conditions included the typical "He Man" introduction (a summary of how He Man got his powers and introduction of main characters), the same "title page," and the same beginning episode with Evil Lynn and Triclops plotting to take over Eternia (the He Man world). The first 2.5 minutes of each tape, therefore, were exactly the same. This decision was made for three reasons: (1) all children watching the stories would develop similar story expectations; (2) this content provided background information for children who had not seen the program before; and (3) the program introduction provided a period for children to become acclimated to performing the secondary task. Rice (personal communication, May 16, 1984) noted that when using the secondary task method with preschool children, it took them about a minute to "settle into" the experimental task. The acclimation period, therefore, was excluded from analysis.

Photographs used in the testing session for this part of the experiment were pictures of still frames from the "He Man" video tapes. Two criteria were used to select the photographs: (1) they had to represent episodes they were taken from so it would be clear what story content was associated with each picture; and (2) photographs used in the sequencing task for the story structure and nonstory structure conditions had to be from the same point in elapsed time in each program. Each photo was a 3" X 5" color print.

Apparatus

An Apple II E computer triggered presentation of tones, timed each child's responses to the tones, and recorded the data. Tones were generated by a Model 200 CDK Hewlett-Packard oscillator, and subjects responded to tones by depressing a button on a hand-held joystick.

Measures

Attention. Attention was measured (in milliseconds) by reaction times to the secondary task, requiring subjects to depress a button as quickly as possible after hearing each tone. Because story schema skills were expected to covary with age, it was thought that reaction time differences between high and low schema groups might vary, in part, as a function of differences in motor skills between these groups. In order to control for such variance, a child's average reaction time to the last three practice tones was used as a covariate in the analysis (all children were encouraged to respond as quickly as possible for these last three tones).

Central and Incidental Content. Ten adult judges viewed the story structure tape and after viewing examined each photograph and identified those that represented central story content. Episodes identified by five or more judges were designated "central content episodes;" episodes identified by four or fewer judges were designated "incidental content episodes." Results of this classification procedure were compared to Mandler and Johnson's (1977) scheme for classification of story grammar. Both methods led to the identification of the same episodes as central and incidental. All RTs recorded during the presentation of central content episodes represented attention to central content ($n = 29$); RTs recorded during the presentation of incidental content episodes represented attention to incidental content ($n = 14$). Only episodes that appeared in both story condition tapes were included in the analysis; comparisons made, therefore, are between the same content presented at the same time in each condition.

Story Schema Skills. Story schema skills were measured by the children's performance on the sequencing task and the task of selecting pictures that represented central story content for stories viewed in the first testing session ("Leopold" and "The Three Robbers"). Procedures for scoring the sequencing task are based on those described by Collins (1979). One point was given for each adjacent pair of pictures placed in correct temporal order. The maximum score was 7 points for each story (14 points total). In the second task, children were given points for their picture selection based on the number of judges who had also identified that picture as central story content. The maximum score for the "Leopold" story was 34; maximum score for "The THree Robbers" was 35. These scores were added together to form an index of schema skills. Before adding the scales together, scores were transformed so that all four scales were on a 7-point scale; maximum score on this scale was 28. Based on this score, children were classified into low or high story schema groups. The mean score ($\underline{M}$ = 16.53, S.D. = 4.39) was used as the dividing point (coefficient alpha = .51).

Recognition Items: Both Sessions. Eight items tested memory of content in each story. Each set of questions included items of various difficulty and content from several time points throughout the program. Children were given one point for each correct response, and responses were summed for each story to create the recognition scales. The maximum scale value was 8 points for each recognition scale. For the "He Man" story, two additional recognition scales were constructed for children in the story structure condition: one for recognition of central story content and another for recognition of incidental content. The maximum score for recognition of central items was 5; the maximum for recognition of incidental items was 3.

Results

Effort Allocation

It was predicted that development of story schema would be associated with: (1) reduced overall processing effort and (2) allocation of more capacity in attending to central story content than to incidental story content. It was expected, therefore, that the mean reaction time ($\overline{RT}$) for children in the high schema group would be faster than $\overline{RT}$ for children in the low schema group. In addition, $\overline{RT}$ during the presentation of central story content was expected to be slower than $\overline{RT}$ during the presentation of incidental story content, particularly for children in the high schema skills group. Because schema-based expectations have been shown to help direct attention processes, it was also hypothesized that effort allocation strategies would vary across tape structure conditions. Because of the lack of research in this area, however, specific predictions about the nature of this variance were not made, except to note that the effects of tape structure should be greatest for children in the high schema group who rely more on these expectations to direct attention. All hypotheses were tested with analysis of covariance (reaction time by schema development and tape structure with baseline reaction time). Attention to central and to incidental content was a within-subject factor; schema skill and story structure were between-subject factors; and base-line reaction time was a covariate. Because base-line RT was found to be a significant covariate $F(1,35) = 19.21$, $p < .01$, this effect is controlled in the results reported below. Results of a preliminary analysis of covariance that also included visual attention as a covariate showed that visual attention was not a significant covariate. This variable, therefore, is excluded in the analysis reported here.

Schema Development, Story Structure, and RT. There was a significant main effect for schema development, $F(1,35) = 4.37$, $p < .05$ on children's reaction times (Figure 1). There was no significant main effect for story structure. $\overline{RT}$ for children in the high schema skills group was 566.73; for children in the low schema skills group, $\overline{RT}$ was 769.90. This effect is particularly evident in the nonstory structure condition, although results indicated only an interaction trend in this direction, $F(1,35) = 3.41$, $p = .07$.

Story Content, Story Structure, and RT. There was a significant main effect for type of story content (central and incidental), $F(1,36) = 52.87$, $p < .01$ on children's reaction times (Figure 1). An interaction was also found for type of story content and tape structure on RT, $F(1,36) = 4.56$, $p < .05$. Children in both low and high story schema groups allocated more effort when central story content ($\overline{RT} = 740.52$) was being presented than when incidental story content ($\overline{RT} = 596.10$) was being presented. The interaction between type of story content and tape structure on RT showed that this pattern was enhanced in the story structure condition. Capacity allocated to central content was greater in the story structure condition ($\overline{RT} = 782.60$) than in the nonstory structure condition ($\overline{RT} = 698.45$). Capacity allocated to incidental content, however, was equal across tape structure conditions ($\overline{RT} = 595.75$, story structure; $\overline{RT} = 596.45$, nonstory structure).

Schema Development, Story Content, Story Structure, and RT. It is important to note that not all children treated central and incidental content differently across story structure conditions (Figure 1). For children in the low schema group, capacity allocated to central story content across tape conditions is not significantly different, $F(1,36) = .53$, $p = .48$ ($\overline{RT} = 804.50$ in the story structure condition; $\overline{RT} = 876.80$ in the nonstory structure condition). The amount of effort allocated to incidental

content is also stable for these children between tape structure conditions, $F(1,36) = 1.25$, $p = .28$ ($\overline{RT} = 643$ in the story structure condition; $\overline{RT} = 755.30$ in the nonstory structure condition). For children in the high schema group, however, capacity allocation to central content is a function of story structure. Attention to central content is significantly greater in the story structure condition ($\overline{RT} = 760.70$) than in the nonstory structure condition ($\overline{RT} = 520.10$), $F(1,36) = 7.13$, $p < .02$. Allocation of effort to incidental content, however, was about equal across tape conditions ($\overline{RT} =$ 548.5 in the story structure condition; $\overline{RT} = 437.6$ in the nonstory structure condition), $F(1,36) = 3.02$, $p = .10$.

Memory of Story Content

It was predicted that story schema development would be associated with increased memory of story content, particularly in the story structure condition. This was tested with analysis of variance (total recognition score by schema development and tape structure). The predicted interaction was not significant; however, a significant main effect was found for story schema development, $F(1,36) = 17.19$, $p < .01$. Table 1 shows that story schema development was related to increased recognition scores and that tape structure had no effect on this relationship.

It was also predicted that children in the high story schema group would remember central story content better than children in the low schema group. Results showed a significant effect for story schema development on memory of central story content as predicted, $F = 3.31$, $p < .02$. Children in the high schema group remembered central content better ($M = 90\%$, $n = 10$) than children in the low schema group ($M = 68\%$, $n = 10$). It should also be noted that while children in the high schema group recalled central content ($M = 90\%$) as well as incidental content ($M = 93\%$), children in the low schema skill group remembered incidental content ($M = 87\%$) better than central content (68%).

Efficiency of Allocation Strategy

A measure of efficiency of allocation was created for each child by summing the reaction times to central and to incidental content and dividing by the number of data points. This mean was then divided by the child's score on the total recognition scale, giving an estimate of the amount of capacity allocated in remembering story content. Results showed a significant main effect for schema skills on efficiency of the allocation strategy, $F(1,35) = 8.92$, $p < .05$. Adjusted means are shown in Table 2. Children in the high schema group have more efficient allocation strategies, since they allocated less capacity in remembering story content ($M = 78.92$) compared with children in low schema skill group ($M = 132.87$). It is also interesting to note that the most efficient allocation strategy occurred for children in the high schema group who viewed the nonstory structure condition ($M = 65.14$).

Results Summary

Results showed that the development of story schema, program content (central and incidental), and story structure influence strategies children use to allocate effort when attending to television stories. Schema development is associated with the allocation of less effort (faster reaction times) to the television program, and there is a trend for this to be particularly true in the nonstory condition. All children allocated more effort when central content was presented than when incidental content was presented. This was particularly true in the story structure condition. Although allocation of effort to incidental content did not vary across structure conditions, more effort was allocated to central content in the story structure condition than in the nonstory structure condition. In addition, it was found that children in the low schema group allocated the same amount of effort to central and incidental content, regardless of story structure. Children in the high schema group, however, allocated significantly more effort to central content in the story structure condition than in the nonstory structure condition, and the amount of effort they allocated to incidental content was equal across structure conditions.

Memory of story content was found to be a function of schema development. As schema develop, children are better able to recognize story content. In addition, memory of central content increases with schema development. Children in the high schema group tended to remember central story content as well as incidental content, and children in the low schema group remembered incidental content better than central. The development of story schema was also found to be associated with increased efficiency, the ability to allocate less effort in remembering story content.

Discussion and Conclusions

The basic findings were that story schema development is associated with reduced processing effort, increased memory of central story content, and a more efficient allocation strategy. These results suggest that story schema are important in children's processing of television stories. Findings also indicated that children in the high schema skills group are better able to coordinate and control selection, allocation, and memory processes than children in the low schema skills group.

High Schema Group

Children in the high schema group allocated less effort when attending to the television story, and allocation for these children was strategic, investing more effort when attending to central story content than to incidental story content. The finding that these children allocated capacity differently across tape structure conditions is important and indicates that allocation strategies are a function of perceived task difficulty and become more flexible as story schema constructs become more stable. As will be recalled, children in the low schema skills group allocated the same amount of effort in attending to both tape structure conditions and children in the high schema group allocated significantly less attention in the nonstory structure condition.

Since mean recognition scores were unaffected by story structure manipulations for both low and high schema groups, it cannot be argued that effects of story structure on the amount of effort allocated in attending to differently structured programs was a function of actual differences in processing demands. Instead, it appears that children in the low schema group did not alter their allocation strategies between structure conditions simply because they were

unaware of the structure manipulation. When asked if they noticed anything different about the "He Man" story they had just seen from those they watch at home, only 1 child (out of the 10 low schema children in this condition) reported being aware of the structure manipulation, stating that watching the program was "kind of like skipping pages." In contrast, five of the ten children in the high schema group reported being aware of the structure manipulation, suggesting that these children allocated less effort in attending to the nonstory structured program, because they perceived the task to be less difficult than watching a "He Man" program structured like a story.

In addition, the finding that only children in the high schema group allocated effort differently in attending to central content between structure conditions is further evidence of the flexibility of their allocation strategies and also suggests that allocation is guided by the meaning of content within a story. When meaningful, children in the high schema group allocated more effort in attending to central program content. When program structure was manipulated so that this same content was no longer important to the story, children allocated significantly less effort in attending to that content. This finding, of course, is consistent with research by Britton and his colleagues who found that readers allocated more capacity to reading stories which are more meaningful to them (g.g., Britton, et al., 1978). The story structure condition invited children to process content at a semantic level, and children who had the ability to integrate episodes allocated more capacity in the story structure condition. When this type of integration is not possible or is not meaningful, less attention is allocated in attending to the television story.

Children in the high schema group also remembered program content better than children in the low schema group, particularly central story content. These findings indicate that children in the high schema group utilized instantiation procedures in storage and retrieval processes and that memory is also influenced by story schema when attending to television stories. It is clear, therefore, that children in the high schema group displayed a great deal of coordination in their allocation strategies between what was selected for attention, what was required for effective task performance, and what was remembered.

Low Schema Group

Although selection strategies for children in the low schema group were strategic in that they allocated more effort in attending to central story content than to incidental content, these strategies proved to be inflexible and do not exhibit characteristics of schema processing. As already discussed, the fact that strategies for allocating effort for attending to central and incidental content did not vary between tape structure conditions for children in the low schema group indicates that these children do not allocate effort on the basis of the meaning of content within a particular story. Instead, these children seem to rely more on stimulus cues to identify central content. Just as Anderson and his colleagues suggested that children learn certain stimulus characteristics are associated with the presentation of comprehensible program content, it is suggested that children also learn that similar cues

exist for identifying central story content. Children in the low schema group rely more on external cues for identifying central content and will, therefore, allocate more effort to this content, regardless of story structure or the meaning of that content in the program.

It is also interesting to note that children in the low schema group remembered incidental story content better than central content, even though they allocated more effort in attending to central story content. This finding reflects poor coordination of selection, allocation, and memory processes, leading to the conclusion that attention strategies employed by these children do not exhibit schema-based processing characteristics. This finding also suggests that there is little television producers can do to assist children who lack the ability to integrate program episodes by employing techniques designed to increase attention to important story content. Results suggest that story schema skills are necessary conditions for the effective integration of story episodes and that even if special features are employed to draw attention to important content, the allocation of attention and effort alone will not insure that children will integrate episodes. It appears, therefore, that although production techniques can be successful in drawing a child's attention to central content episodes within a television story and comprehension of these episodes may be improved, such techniques will not facilitate integration of program episodes and lead to an understanding of how episodes are related.

Conclusions

Results show that the development of story schema skills enables the execution of effective strategies for attending to television stories. Mature attention strategies are characterized by their flexibility and a great deal of coordination between what is selected for attention, what is required for effective task performance, and what is remembered.

The study also shows that attention to television stories involves more than visual selection of program content. The paradox raised by Anderson and Smith (1983) noted that even though young children's visual selection is strategic, these children often are unable to comprehend programs. By defining attention as both selection and allocation of cognitive effort and measuring attention through the dual task method, this paradox is resolved. It was found that effective task performance requires more than strategic selection; it also requires the ability to utilize story schema skills in integrating program episodes, in allocating cognitive effort, and in organizing information in memory. What seems to be important, therefore, is not simply what content children look at when watching television stories, but, more importantly, what children do with that content.

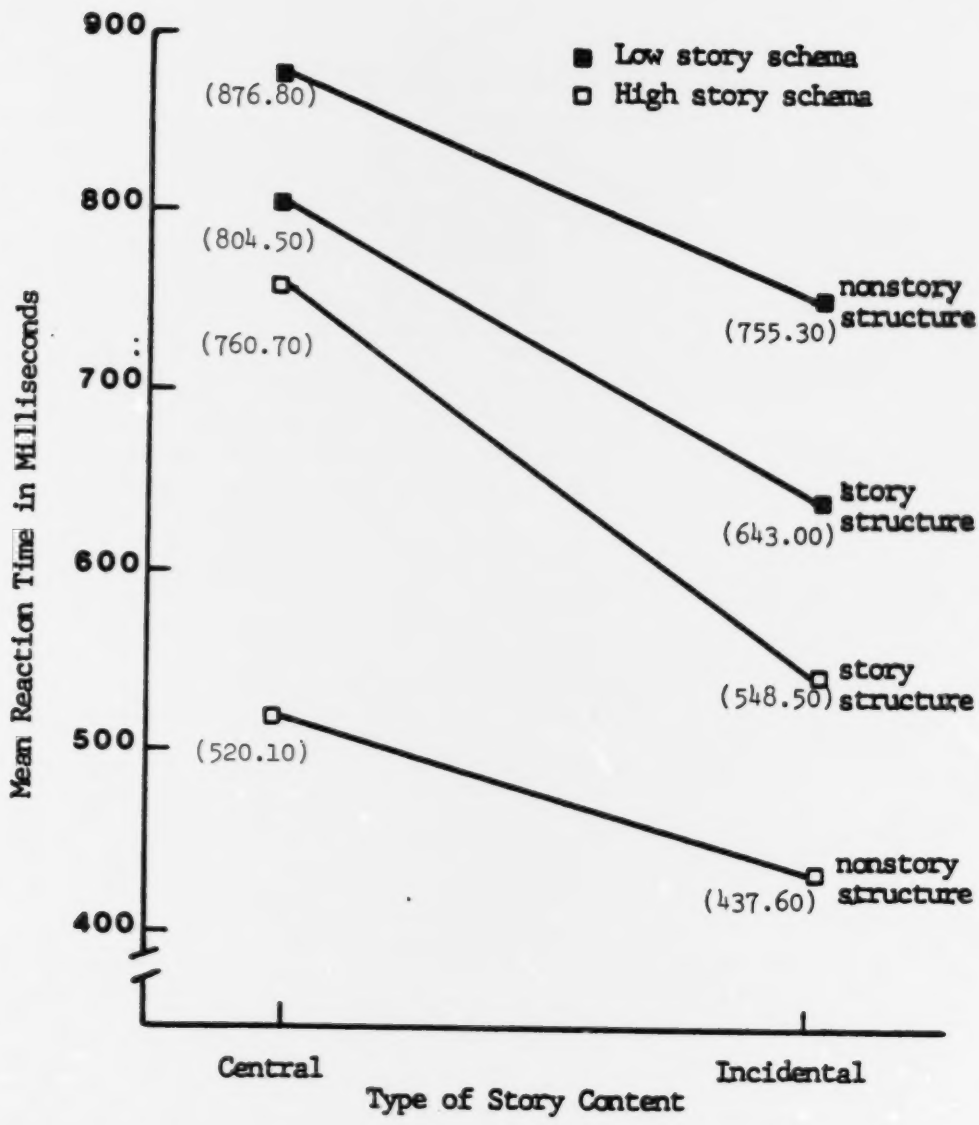

Figure 1. Mean Reaction Time (in milliseconds) to Central and Incidental Content by Schema Skill and Tape Structure.

Table 1

Mean Recognition of Story Content by
Schema Skill and Tape Structure

Tape Structure	Story Schema: Low	Story Schema: High	
Story	6.00 (10)	7.30 (10)	(20)
Nonstory	6.10 (10)	7.40 (10)	(20)
	(20)	(20)	n=40

Note. Maximum score on the recognition task for the "He Man" stories = 8.

Table 2

Mean Proportion of Effort to Recognition
by Schema Skill and Tape Structure

Tape Structure	Story Schema: Low	Story Schema: High	
Story	126.80 (10)	92.69 (10)	(20)
Nonstory	138.93 (10)	65.14 (10)	(20)
	(20)	(20)	n=40

Note. Means reported here are adjusted means, controlling for children's baseline reaction time.

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